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Interface Specification

INNER TRIPLET QUADRUPOLE MQXB

Abstract

MQXB quadrupoles are the principal component of LHC inner triplet LMQXB assemblies. This specification defines the mechanical and electrical interfaces of the MQXB quadrupole, which are relevant for the incorporation of these elements into the LMQXB cold mass assembly and subsequently into the cryostat which completes the LQXB cyro-assembly.

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History of Changes

Rev. No.	*Date*	*Pages*	*Description of Changes*
1.0	2001-03-08		Initial submission
1.1	2001-04-17	1,4,5 6 6	Update equipment codes to current nomenclature. Heater wire changed to 20 gauge. Added CDD drawing number for reference [3].
1.2	2001-06-22	5 6	Added beam tube dimensions. Corrected text to reflect 20 gauge heater wire.
1.2	2001-07-11	all	First released version

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1. INTRODUCTION

Each inner triplet of LHC [1] is assembled from a set of components, including the main quadrupole elements MQXA and MQXB, and corrector elements MCBX, MCBXA, and MQSXA (Figure 1). Two MQXB quadrupoles [2] are the principal component of the LMQXB helium vessel. In addition to providing the main quadrupole field, the MQXB provide mounting points for the MCBX corrector, end domes, and helium containment pipe.

The MQXB are designed and produced by Fermilab, and incorporated with other components into helium vessels and cryostatted assemblies (LQXB) by Fermilab as well. This specification defines the mechanical and electrical interfaces of the MQXB quadrupole, which are relevant for the incorporation of these elements into the LMQXB cold mass assembly and subsequently into the LQXB cryo-assembly.

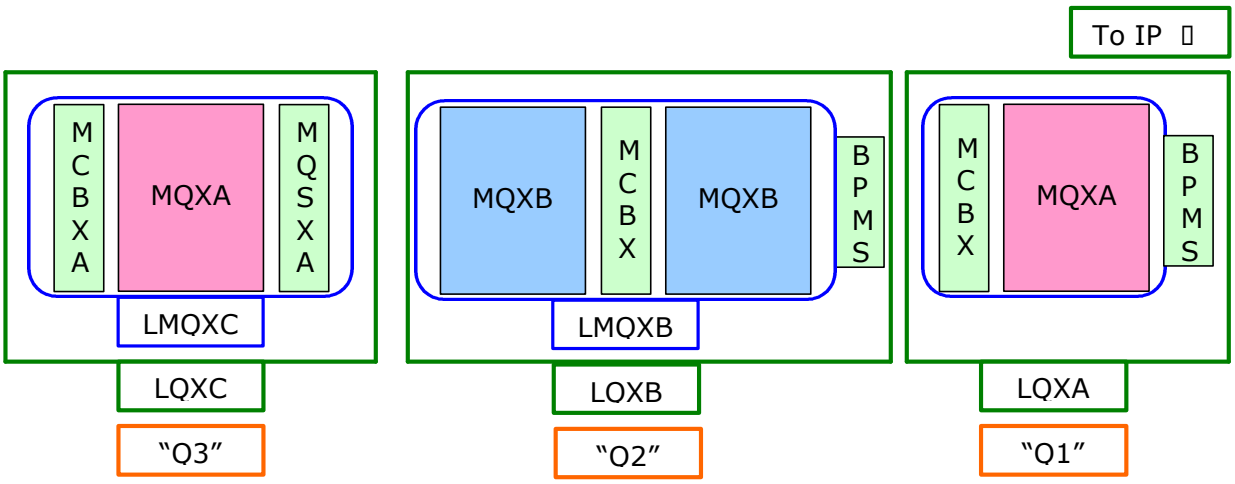

Figure 1. Layout of one side of an interaction point showing assembly packages

2. MQXB INTERFACES

2.1 MECHANICAL

The MQXB quadrupole mechanical interfaces are defined in [3]. This drawing defines:

- The diameter, length and weight of the magnet,
- The longitudinal position of the magnetic center relative to the end plates,
- Stay-clear areas for the attachment of cryostat supports,
- End plate features required for welding an end dome to one end of the magnet and the bridge that connects the two Q2 modules together at the other end,
- The azimuthal orientation of the alignment keys,
- The envelope of the lead splice block, and

- The array of holes used for mounting the MCBX dipole corrector to the non-lead end plate.
- Holes for mounting the temperature sensors and warm-up heaters will be added later when the configurations of these devices are fully defined.

The bore of the MQXB coil has a 70mm inside diameter, allowing for the insertion of an insulated beam tube, after assembly of two MQXB, together with an MCBX, to form an LMQXB cold mass. The OD/ID of the beam tube is 66.7/63.0mm. After insulation the OD is 67.1mm.

2.2 ELECTRICAL

The MQXB has two 13kA leads extending from the lead end of the assembly. The leads will be labelled A and B according with the CERN standard [4]. Looking from the lead end, The "A" lead lies on top of the "B" lead, with the cold mass oriented as shown in Figure 2. The leads exiting the splice block are 2m long, such that further routing and splicing can be completed.

The "B" leads of two MQXB that make up the LMQXB assembly will be connected together with a 13 kA bus bar routed through the lower MQXB bus bar slot, while the "A" leads will form the leads for the LMQXB assembly. The leads protruding from the LMQXB assembly will be re-labelled "A" and "B" in accordance with CERN standard [4].

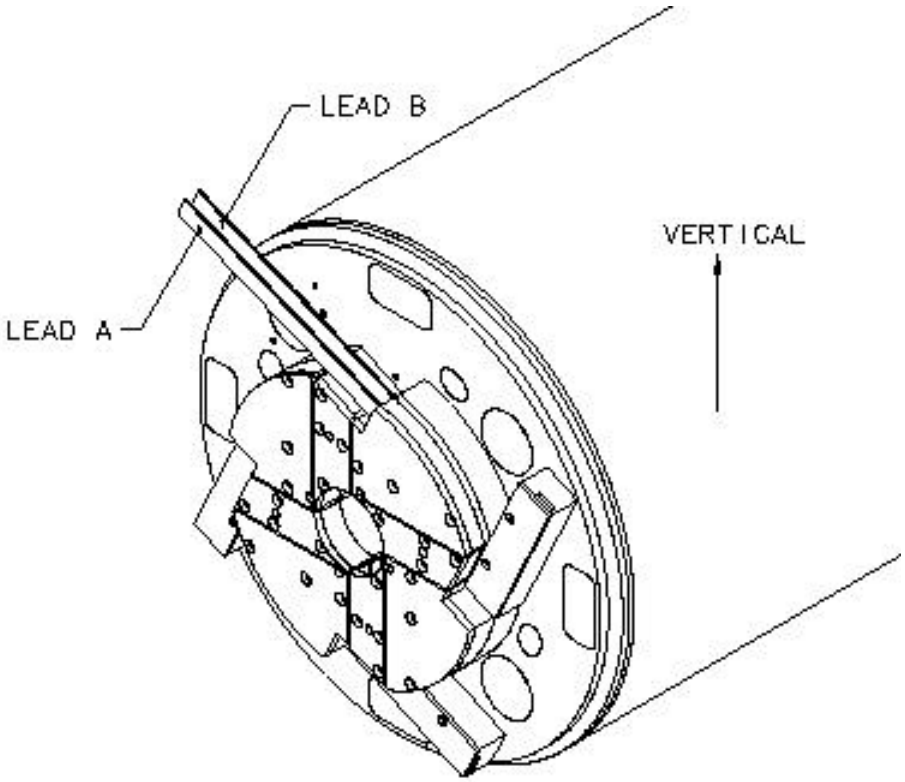

Figure 2. A and B leads on a completed MQXB assembly

The instrumentation and control wiring required for the MQXB is listed in Table 1. All voltage tap and quench heater wires exit from the lead end of the magnet. Temperature sensor and warm-up heater wires, which originate at the non-lead end of the magnet, will be routed through the Q2b from both the Q2a and the Q2b when the two are assembled together into an LMQXB cold mass. Each wire will be labelled indicating functionality and, for voltage taps, location.

Each magnet has 6 voltage taps, attached to the leads and midpoint of the coils. There are two taps for redundancy at each location. The voltage tap wire is 26 gauge in accordance with [5], and each wire is 16 m long when the MQXB is delivered for assembly.

The MQXB has 2 parallel quench protection circuits, resulting in 4 wires 20 gauge, each 16m long, exiting the lead end of the magnet.

Two temperature sensors are attached to the non-lead end of the magnet for cryogenic measurement and control. The thermometers are attached at final assembly to the MQXB end plates. The temperature sensor wires are 30 gauge, each 9m long.

Two 120 W warm-up heaters are attached to each non-lead end of the magnet. These units are attached at final assembly, to the MQXB end plates. The leads of the heaters are 26 gauge, each 9m long.

Table 1. Instrumentation and control wiring. The external lengths are measured from the lead end plate for the voltage tap and quench heater wires and from the non-lead end plate for the temperature sensor and warm-up heater wires.

Lead	Length	Description
Voltage taps	16 m	2 cables (3-#26 AWG wires each)
Quench heaters	16 m	2 twisted pairs (total 4 wires, #20 AWG.)
Temperature sensors	9 m	2 twisted quads (total 8 wires, #30 AWG.)
Warm-up heater	9 m	2 twisted pairs (total 4 wires, #26 AWG.)

2.3 ALIGNMENT

Alignment information for the MQXB is transmitted via the alignment notch in the skin alignment keys[1]. These keys are in intimate contact with the yoke, and are welded in place during the yoke and skinning portion of magnet assembly. The notch provides continuous reference to the magnetic axis along the length of the magnet. As shown in [3], these keys are aligned with the magnet poles in the second and fourth quadrants as viewed from the lead end.

3. REFERENCES

[1] INNER TRIPLET SYSTEMS AT IR1, 2, 5, AND 8, CERN Functional Specification LHC-LQX-ES-0001.

[2] INNER TRIPLET QUADRUPOLE MQXB, CERN Functional Specification LHC-LQX-ES-0002.

[3] LHC IRQ CRYOSTAT MQXB (Q2A & Q2B) INTERFACE SPECIFICATION, LHCMQXB_0001, (Fermilab drawing 5520-ME-390107).

[4] LHC MAGNET POLARITIES, CERN Specification LHC-DC-ES-0001.00, rev 1.1, 27 April 1999.

[5] INSTRUMENTATION WIRES, CONNECTION TECHNIQUES AND FEEDTHROUGHS FOR THE LHC CRYOMAGNETS AND THE QRL, CERN Specification LHC-QI-ES-0001, rev 2.0, 27 September 2000.